Received: 24 November 2020 | Accepted: 24 November 2020

DOI: 10.1111/jvim.15994

ABSTRACT

Journal of Veterinary Internal Medicine Open Access

ACVIM American College of Veterinary Internal Medicine

12th Annual European College of Equine Internal Medicine Congress

20-23 November 2019
Valencia, Spain

The European College of Equine Internal Medicine (ECEIM) Congress and the Journal of Veterinary Internal Medicine (JVIM) are not responsible for the content or dosage recommendations in the abstracts. The abstracts are not peer reviewed before publication. The opinions expressed in the abstracts are those of the author(s) and may not represent the views or position of the ECEIM. The authors are solely responsible for the content of the abstracts.

RESEARCH ABSTRACTS - ORAL PRESENTATIONS

ABSTRACT SESSION 1
FRIDAY 21ST NOVEMBER 12.45-13.45

Effect of Vaccination with Human Tyrosinase DNA in Horses with Melanoma in Comparison to Untreated Horses.

Julia Echelmeyer [1], Riccarda Peckary [2], Julien Delarocque [1], Martina Patzl[3], Karsten Feige [1], Jessika-M.V. Cavalleri [2]

[1] Clinic for Horses, University of Veterinary Medicine Hannover, Foundation, Hannover, Germany. [2] University Equine Clinic, Department of Small Animals and Horses, University of Veterinary Medicine Vienna, Austria. [3] Institute of Immunology, University of Veterinary Medicine Vienna, Austria.

Equine melanoma is the most common skin tumor in grey horses. Different treatment options are described mainly with low prospects for sustained tumor regression. The vaccination with human tyrosinase DNA showed successful results in the treatment of canine melanomas. Twenty-eight grey horses with melanomas were treated with transdermal injections (VET JET® transdermal vaccination system, Merial) of xenogenic plasmid DNA encoding human tyrosinase (Oncept® Canine Melanoma Vaccine, Merial). Vaccination was performed on day 0, 14, 28, 42 and every 6 months thereafter. In each horse, calliper measurements of the size of 2-5 selected melanomas were performed prior to each vaccination. The group of vaccinated horses was compared to a group of untreated grey Lipizzaner stallions with melanomas (n= 20) in a robust linear mixed model. Median follow-up duration was 231 days in the vaccinated group and 126 days in the controls. The group of vaccinated horses showed no significant increase of tumor volumes, whereas the melanomas in untreated horses significantly expanded over time ($P<0.001$). DNA-vaccination with human tyrosinase therefore resulted in a stagnation of melanoma growth indicating that DNA-vaccination with human tyrosinase induces systemic antitumoral effects. While tumor regression could not be achieved, stagnation of melanoma volume can be regarded a significant result. Long-term large-scale studies are still required to further assess this promising therapeutic option. Key words: DNA vaccination, horse, melanoma, tyrosinase

In vitro assessment of betulinic acid derivative NVX-207 as a topical treatment for equine sarcoids

Lisa A. Weber[1], Jessica Meißner[2], Jutta Kalbitz[3], Julien Delarocque[1], Manfred Kietzmann[2], Karsten Feige[1], Anne Michaelis[4], Reinhard Paschke[4], Sabine Brandt[5], Jessika-M.V. Cavalleri[6]

[1]Clinic for Horses, University of Veterinary Medicine Hannover, Foundation, Hannover, Germany [2]Department of Pharmacology, Toxicology and Pharmacy, University of Veterinary Medicine Hannover, Foundation, Hannover, Germany [3]Biosolutions Halle GmbH, Halle (Saale), Germany [4]Biozentrum, Martin-Luther University Halle-Wittenberg, Halle (Saale), Germany [5]Research Group Oncology, Equine Surgery, University of Veterinary Medicine Vienna, Vienna, Austria [6]University Equine Clinic, University of Veterinary Medicine Vienna, Vienna, Austria

Currently available therapies for equine sarcoids (ES) are often inefficient. Therefore, betulinic acid-trisester (NVX-207), a derivative of the naturally occurring anticancerogenic betulinic acid, was assessed for its potential as a topical treatment for ES *in vitro*. Primary ES cells (sRGO1; sRGO2) were incubated with NVX-207 in nine concentrations ranging from 1-100 μmol/L for 5, 24 and 48 hrs. Cell proliferation and viability were analyzed by crystal violet staining and CellTiter 96® AQueous One Solution (MTS) assay, respectively. Half-maximal inhibitory concentrations (IC_{50}) were determined in 6-8 biological replicates (two technical replicates each). Furthermore, 1% NVX-207 in "Basiscreme DAC" was evaluated for its permeation through isolated equine skin (800 μm thickness; n=6, two technical replicates per sample) within 24 hrs using Franz-type diffusion cells. Following incubation, NVX-207 was extracted from skin slices (20 μm thickness) and a depth profile of the compound in the permeated skin was determined by HPLC analysis. NVX-207 showed antiproliferative and cytotoxic effects on ES cells in a time- and dose-dependent manner with IC_{50} values amounting to 3.8 μmol/L for sRGO1 and 2.9 μmol/L for sRGO2 in cytotoxicity assay after 24 hrs. Detected amounts of NVX-207 in the different skin layers by far exceeded the calculated IC_{50} values. Obtained *in vitro* data hence indicate that NVX-207 may be used alone or in combination for topical treatment of ES. Safety and *in vivo* antitumoral effects of the pharmaceutical formulation need to be assessed in clinical studies in horses. Keywords: Equine sarcoid, betulinic acid derivative, NVX-207, Franz-type diffusion cell

Ex Vivo Comparison of Ultrasonographic Intestinal Wall Layering with Histology In Horses

Kari Bevevino [1], John F. Edwards [2], Noah Cohen [1], Cris Navas de Solis[1]

[1]Department of Large Animal Clinical Sciences, Texas A&M University, College Station, TX, [2]Department of Veterinary Pathobiology, Texas A&M University, College Station, TX

The objective of the study was to compare the ex vivo sonographic layering pattern, and thickness measurements of the intestinal wall and each of the intestinal wall layers with histology. Twelve horses were euthanized for reasons unrelated to gastrointestinal disease. Samples of the duodenum, jejunum, ileum, cecum, right dorsal colon, and small colon were collected and imaged in an isotonic bath within 1 hour. Samples were fixed, re-imaged and evaluated histologically. Digital histologic and sonographic measurements of each intestinal segment and sonographic and histologic layers were obtained and agreement evaluated using Bland and Altman analysis. Limits of agreement were set to 1 mm for total wall thickness and 0.5 mm for individual wall layers. In 70 of 72 samples there was a 5-layer pattern of alternating echogenicity. There was good agreement between histologic and sonographic measurements for all segments with the exception of the ileum. Formalin fixation did not alter the sonographic appearance or wall measurements. The current quality of sonographic imaging makes detailed evaluation of the gastrointestinal tract wall feasible. Images of a 5-layer pattern of alternating echogenicity and accurate measurements of the total wall thickness and individual layers can be obtained sonographically in ex vivo intestine. Detailed ultrasounds of the intestinal tract could be clinically valuable in horses with intestinal disease and this impression should be tested prospectively; fixed samples are appropriate for prospective studies. The additional detail observed may allow the clinician to better define abnormalities, rank differential diagnoses, and develop a clinical plan. Keywords: Ultrasound, imaging, gastrointestinal

Phosphorylated Neurofilament Heavy Subunits as an Antemortem Biomarker in Equine Neurodegenerative Diseases

L Edwards, [1] DVM, S Reed, [2] DVM, DACVIM, CJ Finno, [3] DVM, PhD, DACVIM

[1]WR Pritchard Veterinary Medical Teaching Hospital; [2]Rood and Riddle Equine Hospital, Lexington, Kentucky; [3]Department of Population Health and Reproduction, School of Veterinary Medicine, UC Davis.

Equine neuroaxonal dystrophy (eNAD) is a neurodegenerative disease affecting horses in the first year of life and equine degenerative myeloencephalopathy (EDM) is a more severe pathological variant of eNAD. Currently, there is no antemortem diagnostic tool available for eNAD/EDM and the disease may go unrecognized on postmortem evaluation due to the subtlety of histopathological changes. Phosphorylated neurofilament heavy subunits (pNfH), a structural protein of the neuronal cytoskeleton, have been utilized in other species as a biomarker for neurodegenerative diseases, such as amyotrophic lateral sclerosis in humans and canine degenerative myelopathy. The use of pNfH as a biomarker could provide useful antemortem diagnostic information. The objective of this study was to compare blood and CSF concentrations of pNfH in healthy non-neurologic horses and horses affected with eNAD/EDM and CVCM using a species validated ELISA kit. pNfH ELISAs were performed in duplicate on serum and CSF samples from 14 unaffected, 22 eNAD/EDM affected and 25 cervical vertebral compressive myelopathy (CVCM) affected horses, with CVCM and eNAD/EDM confirmed at necropsy. Unaffected horses had normal neurologic examinations. Serum pNfH concentrations were < 2 ng/ml in unaffected horses and CVCM affected horses. pNfH concentrations were significantly higher in both serum (Padjusted= 0.001) and CSF (Padjusted= 0.003) of eNAD/EDM

affected horses compared to unaffected horses. CSF pNfH concentrations were significantly higher in eNAD/EDM affected horses compared to unaffected horses (Padjusted= 0.003) but not significantly different from CVCM affected horses. Serum and CSF pNfH testing can provide useful antemortem diagnostic information regarding neurodegenerative diseases in neurologic horses.

ABSTRACT SESSION 2
FRIDAY 21ST NOVEMBER 12.45-13.45

Evaluation of glycine and riboflavin *in vitro* as therapeutic agents for horses with atypical myopathy

S. González-Medina*, **R.J. Piercy**

Comparative Neuromuscular Diseases Laboratory, The Royal Veterinary College of London, NW1 0TU, UK

Equine atypical myopathy (AM) is an acute, severe and often fatal toxic rhabdomyolysis of grazing horses. Treatment efficacy in horses is limited and most therapies are empirical. Glycine and riboflavin have been tested in rodent models of hypoglycin A intoxication, but their suitability for affected horses has never been examined. This work aimed to test the hypothesis that riboflavin and glycine would protect cultured equine muscle-derived cells from the toxic effects of hypoglycin A's principal metabolite, methylene-cyclopropyl acetic acid (MCPA). Following calculation of toxicity range for MCPA, equine skeletal muscle-derived cells (2 replicates derived from 3 different horses) were incubated for 2h with either glycine or riboflavin at varying concentrations, before addition of 6mM MCPA. After 24h, cell viability was determined by MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) mitochondrial metabolism assay. Riboflavin, but not glycine supplementation was significantly protective, partially mitigating the toxic effects of MCPA *in vitro*. Specifically, pre-treatment with 50μM (p=0.01) and 100 μM (p<0.001) riboflavin reduced cell toxicity by 42% and 74% respectively. Results obtained *in vitro* are encouraging and support further studies. Riboflavin supplementation is recommended for affected horses and might also be helpful as a preventive therapy in horses considered at high risk of sycamore material ingestion.

Keywords: Atypical myopathy, riboflavin, glycine, treatment

Placebo-Controlled Study on the Effect of Velagliflozin Treatment in Insulin Dysregulated Horses During Transition to Pasture

Tobias Warnken[1], Julien Delarocque[1], Florian Frers[1], Svenja Schenzel[1], Karsten Feige[1], Dania Reiche[2]

[1] Clinic for Horses, University of Veterinary Medicine Hannover, Hannover, Germany [2] Boehringer Ingelheim Vetmedica GmbH, Ingelheim am Rhein, Germany

Insulin dysregulated (ID) horses are prone to develop laminitis. Recent studies show promise that ID may be improved and laminitis may be prevented by the sodium-glucose linked cotransporter 2 (SGLT-2) inhibitor velagliflozin. The aim of the study was to investigate the metabolic responses and efficacy of velagliflozin treatment during the transition from winter hay feeding to pasture. Nineteen Icelandic horses were monitored. Six horses were metabolically healthy (H) and thirteen were insulin- dysregulated (ID), of which seven were treated three weeks prior to transition to pasture with velagliflozin (ID-V), once daily orally at 0.3 mg/kg body weight (BW), while the six others were treated with a placebo (ID-P). Parameters related to ID (e.g., insulin, glucose, and leptin) were measured at resting state and in response to oral glucose tests (OGT, 0.5 g glucose/kg BW, nasogastric tubing). After transition to pasture, in comparison to their pre-pasture metabolic status, ID-P horses exhibited a worsened ID, i.e., an increase of resting insulin and leptin levels. The baseline corrected $AUC_{OGT\ insulin}$ was increased in ID-P ((geomean, μIU/mL) 72.5 -> 86.7), slightly reduced in H (40.5 -> 33.6), and significantly decreased in ID-V (71.2 ->43.8; p = 0.004). There was no significant difference in response to the final OGT between H and ID-V. No case of clinical laminitis occurred. In conclusion, transition to pasture represents a metabolic challenge for ID horses. The results of the present study indicate that velagliflozin improved equine ID to the metabolic status of healthy horses and was well tolerated.

The Effect Of Season, Feeding, and Weight Variations on Insulin Dysregulation in Horses

Justin Box, Anna Mykkänen, Marja Raekallio, Ninja Karikoski

Department of Equine and Small Animal Medicine, Faculty of Veterinary Medicine University of Helsinki

To determine the seasonal variation in insulin response to an oral sugar test (OST). Twenty-eight Finnhorses were enrolled in a prospective cohort study. Horses were fasted overnight then received 0.45 ml/kg corn syrup orally. Blood samples taken at 0, 60, 90, and 120 minutes were analyzed for serum [insulin] using a chemiluminescent assay. Physical measurements, BCS, weight (tape and scale) were recorded. Horses were categorized as insulin dysregulated if [insulin] was ≥20 μIU/ml at T0 or ≥40 μIU/ml at either T60, T90, T120 or all. OSTs and measurements were performed every other month June 2018-February 2019. [Insulin] T60, T90, and T120 differed significantly in Jun/Feb and Dec/Feb. BCS did not differ; however, scale weight (Jun/Oct) and weight tape (Aug/Dec and Dec/Feb) had significant differences. Comparison of ID v. non-ID horses yielded mixed results with T60 being the only time point that differed significantly in all months. T0, T90, and T120 were significantly different in three of five months. Area under [insulin] curve was significantly different in every month but August. Three horses were ID in all months with the highest number of ID horses occurring in Dec (n=10). Mean [insulin] varied throughout the study with the highest in Dec and lowest in Feb. In this cohort using a 0.45 ml/kg OST, season appears to play a role in insulin response. ID status can vary throughout the year; therefore, interpretation of an OST in various seasons and in other breeds should be used as part of a more comprehensive diagnostic plan.

Key words: OST, insulin dysregulation, seasonal variation, equine

Effect of α-tocopherol deficiency and repletion on skeletal muscle morphology in horses.

Lauren Bookbinder[1], Carrie J. Finno[2], Anna M. Firshman[3], Amanda Borer[1], Scott Katzman[4], Stephanie Valberg[1];

[1] Veterinary Clinical Sciences, Michigan State University; [2] Population Health/Reproduction, University of California, Davis; [3] Veterinary Population Medicine, University of Minnesota; [4] Surgical/Radiologic Sciences, University of California, Davis

Vitamin E deficient myopathy (VEM) in horses appears to be distinct from other equine vitamin E-related diseases. VEM is characterized by low alpha-tocopherol (a-TOH) concentrations, insidious muscle atrophy, weakness, and abnormal mitochondrial staining of the sacrocaudalis dorsalis medialis muscle (SC). We hypothesized that clinically normal, serum a-TOH deficient horses would demonstrate histologic and ultrastructural SC abnormalities, which would be ameliorated by a-TOH repletion. Our objectives were to quantify the effects of a-TOH deficiency and subsequent supplementation on SC mitochondrial staining, fiber morphology, fiber type composition, and ultrastructure. Blood and SC biopsies were obtained from 16 clinically normal a-TOH deficient adult horses before and 8 weeks after supplementation (n = 8; 5000 IU/day oral water dispersible a-TOH) or no supplementation (n = 8). A significant increase in serum a-TOH occurred in supplemented horses (1.2 ± 0.3 ug/mL to 2.6 ± 0.5 ug/ml, $p < 0.0001$). Prior to treatment, 4/8 control and 4/8 treatment horses were diagnosed with VEM based on blindly scored histopathologic abnormalities. Supplementation with a-TOH significantly improved scores for mitochondrial staining ($p = 0.045$), fiber size variability ($p = 0.005$) and fiber splitting ($p < 0.0001$), with a trend for increased fiber areas ($p = 0.069$) and no change in the type 1 fiber predominance. Electron microscopy demonstrated SC lipofuscin accumulation before and after a-TOH supplementation. In conclusion, histologic and ultrastructural changes exist in the SC of clinically normal a-TOH deficient horses, which improve but do not resolve following 8-week a-TOH supplementation.

ABSTRACT SESSION 3
FRIDAY 21ST NOVEMBER 12.45-13.45

Comparison of Electrocardiogram Quality from Smartphone-Based and Standard ECG Devices in Healthy Horses and Horses with Atrial Fibrillation

Ellen Paulussen, Lisse Vera, Glenn van Steenkiste, Annelies Decloedt, Dominique De Clercq, Gunther van Loon

Equine Cardioteam Ghent University, Department of Large Animal Internal Medicine, Faculty of Veterinary Medicine, Ghent University

Smartphone-based ECGs are increasingly used in horses but have not specifically been assessed during atrial fibrillation (AF). In 23 healthy and 24 AF horses a standard electrocardiogram (ECG) (Televet100, Kruuse) was recorded at rest together with different smartphone-based ECGs: three AliveCor devices (veterinary AC-002, human AC-009 and self-adapted (larger spacing between electrodes) AC-009 device) were tested, each with 2 applications (AliveCorVet (veterinary) and Kardia (human)). The automatic AF detection algorithm of the Kardia application was checked for accuracy. ECGs were blinded and scored for baseline wander and presence of artefacts, P or f-wave visibility and overall quality. Smartphone-based ECGs were compared with the standard ECG using the non-parametric Friedman's 2-way analysis of variance by ranks. In SR only the self-adapted AC-009 scored equally compared to the standard ECG for all criteria, independent of the application used. In horses with AF the overall quality of the ECG was significantly lower for all smart-phone based devices compared to standard ECG and P and f-waves could hardly be identified on 42/161 and 39/168 ECGs, respectively. However f-wave visibility with the self-adapted AC-009 scored equally compared to the standard ECG. Automatic ECG analysis by the Kardia application detected AF correctly on 48/72 ECGs, incorrectly on 6/69 ECGs, detected SR only on 2/69 ECGs and was unable to make a diagnosis in the remaining 87 ECGs. This data suggests that electrode spacing has an important impact on P and f-wave visibility, and that automatic Kardia analysis is not reliable for detection of AF in horses. Keywords: electrocardiogram, arrhythmia, smartphone

Atrial Fibrillation as Risk Factor for Exercise-Induced Pulmonary Hemorrhage During a Standardized Exercise Test

Sanni Hansen, Charlotte Hopster-Iversen, Julie Fjeldborg, Merle Fenner, Eva Z. Hesselkilde, Helena Carstensen, Rikke Buhl

Department of Veterinary Clinical Sciences, Faculty of Health and Medical Sciences, University of Copenhagen

Atrial fibrillation (AF) may be a risk factor for Exercise-Induced Pulmonary Hemorrhage (EIPH) because of an increased pressure in the left atrium. The aim of this study was to evaluate if AF was associated with an increased likelihood of EIPH after a standardized exercise test (SET) to fatigue.

Ten Standardbred mares were included. The horses performed a SET on the treadmill before (sinus rhythm, SET1) and 25-44 days after induction of self-sustained AF (SET2). AF was induced by tachypacing using an implanted pacemaker. Endoscopy, including bronchoalveolar lavage (BAL), was performed 72-48 hours prior to and 24 hours after the two SETs, in addition endoscopic graduation of tracheal blood was performed 2 hours after each SET. Significant increase in BAL neutrophils was observed 24 hours after SET2 compared to before SET2 ($p=0.043$). Two horses had grade 1 blood in trachea 2 hours after SET2 and three horses had hemosiderophages in BAL 24 hours after SET2. Maximal velocity and HR did not differ between horses with and without visible blood in trachea after SET2. Previous studies have shown that horses with AF had tachypnea and increased pulmonary wedge pressure during exercise. In the present study 3/10 horses showed signs of EIPH when exercising in AF compared to sinus rhythm demonstrating a possible link between AF and EIPH. However, a larger study population is needed to finally conclude that AF predispose for EIPH. Furthermore, the link between EIPH, pulmonary pressure and AF needs to be further elucidated.

Keywords: Exercise induced pulmonary hemorrhage, bronchoalveolar lavage, poor performance, atrial fibrillation

The Effects of Orally Administered Torsemide on Electrolyte Fractional Excretion and Serum Symmetric Dimethylarginine (SDMA) in Healthy Adult Horses

Gustavo F. Agne[1,2], SeungWoo Jung[2], Anne A. Wooldridge[2], Elizabeth A. Spangler[3], Pete W. Christopherson[3], Sue H. Duran[2], William R. Ravis[2], Marco Lopes[1], Amy S. Hall[3]

[1]School of Animal and Veterinary Sciences, University of Adelaide, Roseworthy, South Australia, Australia [2]Department of Clinical Sciences, Auburn University, Auburn, Alabama, USA. [3]Department of Pathobiology, Auburn University, Auburn, Alabama, USA

Torsemide, a potent loop diuretic, has a good pharmacokinetic profile and produces marked diuresis after oral administration in horses. The aim of the study was to investigate the effects of torsemide on fractional excretion of Na+ (FENa+), K+ (FEK+) and Cl- (FECl-), and serum concentration of symmetric dimethylarginine (SDMA) in healthy horses. Torsemide (2mg/kg/q12 hours) was administered orally to 6 healthy mares for 6 consecutive days. Paired blood and urine samples were collected on days 0 (before torsemide administration), 1, and 6, at hours 0, 1, 3, 5, 7, 9 and 11 each day. Treatment effects were assessed with repeated measures ANOVA and the post-hoc Bonferroni test with α at 0.05. Relative to Day 0 (mean±SD), $FENa+_{day0}$ (0.08%±0.05) and $FECl-_{day0}$ (0.55%±0.29) increased on Day 1 ($FENa+_{day1}$= 3.37%±0.97 [p<0.0001]; $FECl-_{day1}$= 6.39%±2.24 [p=0.0002]), but were no longer elevated on Day 6 ($FENa+_{day6}$= 0.71%±0.49 [p=0.2788]; $FECl-_{day6}$= 1.28%±0.75 [p=0.1493]). Relative to Day 0, $FEK+_{day0}$ (16.85%±7.77) increased on Day 1 ($FEK+_{day1}$= 81.93%±30.26 [p<0.0004]), and remained elevated on Day 6 ($FEK+_{day6}$= 67.46%±12.13 [p<0.0032]). SDMA concentration in serum (mean±SD) increased from Day 0 (10.33µg/dL±1.50) to Day 1 (12.17µg/dL±1.26 [p<0.0204]), and was the highest on Day 6 (14.38µg/dL±1.37 [p<0.0002]). These findings indicate that torsemide administration at 2mg/kg/q12 hours induced marked electrolyte excretion and mild increase in SDMA. Torsemide given at a lower dose than used in this study may be safer for diuretic therapy in horses. Further studies in horses with lower doses of oral torsemide are warranted.

Key words: Torsemide, Loop diuretics, Fractional excretion, electrolytes, SDMA

Ultrasonographic Assessment of Early Subclinical Cathether-Related Changes of the Jugular Vein in Hospitalized Horses

A. Dufourni, L. Vera, A. De Vos, A. Decloedt, D. De Clercq, G. van Loon.

Department of Large Animal Internal Medicine, Faculty of Veterinary Medicine, Ghent University, Salisburylaan 133, 9820 Merelbeke, Belgium

Early detection of catheter-related complications is desirable as catheter removal from an affected vein may prevent or reduce the severity of vascular disease. The aim of this study was to detect early subclinical vascular changes by repeated jugular vein ultrasonography. Fifteen horses, catheterized with a 14G polyurethane Milacath® (MILA International, Kentucky) (n=5) or 14G polyurethane Cavafix® Certo (Braun Melsungen AG, Germany) (n= 10) catheter after colic surgery were included. Repeated ultrasonography (Vivid IQ, GE Healthcare, Zaventem) of the entire jugular vein to screen for presence of thrombi and vascular abnormalities was performed using a 9-12 MHz linear transducer (9L-RS, GE Healthcare) starting 12-24h after catheter placement with a 48h interval until catheter removal and 12-24h after catheter removal with a 48h interval until leaving the hospital. At the level of insertion, distal outer catheter and distal inner catheter (Cavafix®) the medial jugular vein wall thickness was measured. Results were analyzed using repeated measures. Mean wall thickness at the level of insertion, distal outer and inner catheter ranged between 0.56 and 1.20 mm but did not increase significantly over time (p=0.770, 0.425, 0.157,respectively). However in 60%(9/15) of the horses subclinical changes could be visualized. Thrombi were present in 40%(6/15), thickened venous valves in 33%(5/15) and a fibrin sleeve partially covering the catheter in 13%(2/15) of the horses. Results indicate that repeated jugular vein ultrasonography can be used to detect early catheter-related changes and might therefore be useful to reduce the incidence and severity of thrombophlebitis in hospitalized horses. Keywords: Phlebitis - Thrombus – Wall thickness

ABSTRACT SESSION 4
SATURDAY 22ND NOVEMBER 10.45-11.45

First Detected Episodes of Paroxysmal Atrial Fibrillation in Horses by an Implantable Loop Recorder

Helena Carstensen[1], Eva Zander Hesselkilde[2], Merle Friederike Fenner[1], Stefan Michael Sattler[2,3], Thomas Jespersen[2], Rikke Buhl[1]

[1]Department of Veterinary Clinical Sciences, Faculty of Health and Medical Sciences, University of Copenhagen, Denmark. [2]Department of Biomedical Sciences, Faculty of Health and Medical Sciences, University of Copenhagen, Denmark. [3]Department of Cardiology, The Heart Centre, Copenhagen University Hospital, Denmark.

Atrial fibrillation (AF) can decrease performance in horses. Initially AF may be paroxysmal AF (PAF) with spontaneous onset and termination. The short durations complicate diagnosis of AF. Implantable loop recorders (ILRs) are small ECG devices placed subcutaneously and programmed to detect arrhythmias by continuously measuring the RR interval. The objective of this study was to test whether ILRs can be used to diagnose PAF in horses.

We enrolled four Standardbreds with a history of intermittent decreased performance of unknown origin. All horses underwent a clinical examination, 24h ECG recording and an echocardiographic examination before implantation of an ILR. The ILRs were placed in the sixth left intercostal space and programmed to detect AF episodes. The horses went back to their regular work load and the ILRs were interrogated every two to six months.

Fig.1 ECG obtained by the implantable loop recorder during an episode of paroxysmal atrial fibrillation. The numbers indicate the time interval (in ms) between each ventricular signal. VS = ventricular sensing.

All of the ILRs showed stable ECG signals throughout the study. In one horse, two PAF episodes of 7.87 and 7.33 hours duration were detected within 5 months. The ECG obtained by the ILR (Fig.1) confirmed the episodes. No other horses had AF episodes registered.

A previous study have shown that ILRs were able to register approximately 80 % of induced AF burden in horses and therefore we cannot rule out that the horses without any registered episodes did not experience PAF during the study.Undiagnosed PAF can have consequences in terms of disease progression and safety for horses and owners; therefore, this study suggests ILRs as an important ECG tool in the clinic for diagnosis confirmation.

Keywords: Atrial fibrillation, implantable loop recorders, ECG

Left Ventricular Function During Atrial Fibrillation and Follow up after Succesfull Cardioversion to Sinus Rhythm in Warmblood Horses

A. Dufourni, A. Decloedt, E. Bellemans, D. De Clercq, G. van Loon.

Equine Cardioteam, Department of Large Animal Internal Medicine, Faculty of Veterinary Medicine, Ghent University, Salisburylaan 133, 9820 Merelbeke, Belgium

Reverse remodeling after cardioversion of atrial fibrillation (AF) to sinus rhythm results in restoration of atrial contractile function and left atrial size. Little is known about the impact on ventricular function. Left ventricular (LV) function was assessed in 30 Warmblood horses treated by transvenous electrical cardioversion or administration of quinidine sulphate for AF at three time points: before cardioversion in AF, at 24 hours and 6 weeks after successful cardioversion. Measurements were performed from M-mode images and tissue Doppler imaging of the LV. Differences between time points were analyzed by univariate linear regression analysis with post-hoc Bonferroni correction for multiple comparisons. Statistical significance was defined as $p < 0.05$. During AF, horses showed a significantly reduced end-diastolic ventricular internal diameter (LVIDd) (11.6±1.0 cm) but heart rate (50±13 bpm) was also significantly increased. LVIDd and fractional shortening (FS) increased progressively after cardioversion, although FS changes did not reach statistical significance. From 24h to 6 weeks in sinus rhythm, the pre-ejection period (102±24 and 88±17 m/s) decreased significantly, while the late diastolic LV myocardial velocity (A wave) (3.9±1.8 and 6.5 ±2.0 cm/s), early diastolic myocardial velocity (E wave) (18.2±4.0 and 19.9±4.2 cm/s) and the A/E ratio increased progressively. This study suggests that left ventricular systolic and diastolic function is reduced during AF and increases progressively after successful cardioversion. The resulting reduced cardiac output may affect cardiac function during exercise. Therefore, assessment of both left ventricular and atrial function might be useful before the horse returns to full athletic performance.

Keywords: Arrhythmia – Equine - Systolic function - Diastolic function

First catheter-based high-density endocardial electroanatomical mapping of the right atrium in standing horses

Eva Hesselkilde[1], Dominik Linz[2], Helena Carstensen[3], Arnela Saljic[1], Rayed Kutieleh[4], Thomas Jespersen[1], Prashanthan Sanders[2], Rikke Buhl[3].

[1] Department of Biomedical Sciences, Faculty of Health and Medical Sciences, University of Copenhagen, Blegdamsvej 3, 2200 Copenhagen, Denmark. [2] Centre for Heart Rhythm Disorders, Royal Adelaide Hospital and University of Adelaide, Adelaide, Australia. [3]Department of Veterinary Clinical Sciences, Faculty of Health and Medical Sciences, University of Copenhagen, Højbakkegaard Allé 5, 2630 Taastrup, Denmark. [4]Abbott Medical, Australia

In humans, catheter-based mapping of voltage and activation times of endocardial atrial bipolar electrograms (EGM) is used to identify arrhythmia mechanisms and to characterize electroanatomical substrates. We tested, whether this technique could be used in standing horses.

Four Standardbred horses (2 geldings, 2 mares, mean age 5 [4-9] years, mean body weight 485 [440-550] kg) were sedated (0.01mg/kg detomidine, 0.01mg/kg butorphanol followed by constant rate infusion of 1.0 mg/ml xylazin). Through an 11F sheath in the jugular vein, a high-density multipolar grid catheter (Figure (A), Advisor™ HD Grid Mapping Catheter, Abbott, St. Paul, MN, USA) in conjunction with a cardiac 3D-electroanatomical mapping system (EnSite Velocity™, Abbott) were used for endocardial mapping of the right atrium.

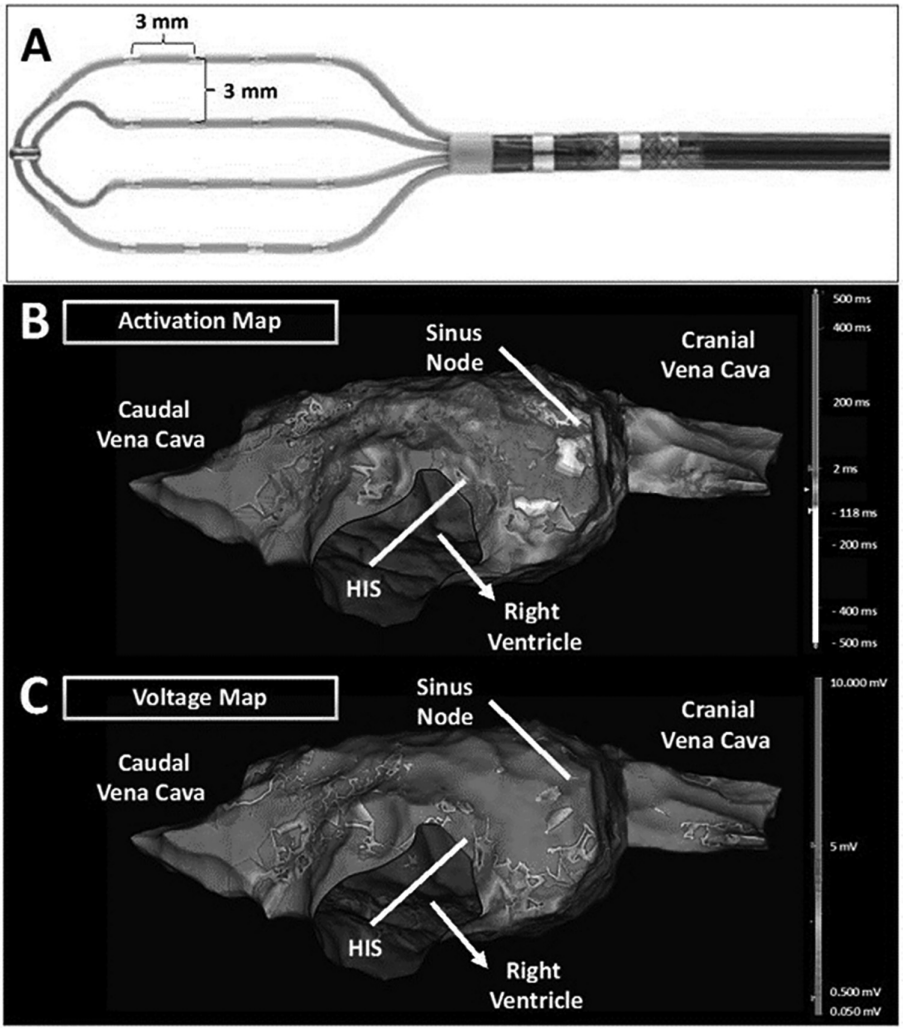

Fig. 1. Advisor™ HD Grid Mapping Catheter (A). Representative activation (B) and voltage (C) map of the right atrium. Colour scale bar indicates activation time (ms) with the earliest activation in the sinus node (B) and voltage amplitudes (mV) of local electrograms (C).

A decapolar diagnostic catheter (Livewire™, Abbott) was placed in the caudal vena cava for anatomical location reference. The P-wave in the surface ECG was used as a timing reference for simultaneous local activation time- and bipolar voltage-mapping.

Endocardial right atrial mapping guided by the 3D-mapping system and local EGMs could be successfully performed in all four horses. A median of 6469 [5143-9069] EGMs in each animal were collected and analysed. 3D-electroanatomical mapping provided detailed information about activation patterns and EGM-characteristics of the cavotricuspid isthmus, crista terminalis, sinus node and HIS region. Figure 1 illustrates a representative activation (B) and voltage (C) map.

In summary, fluoroless high-density mapping of the right atrium is feasible in the standing horse and may be helpful in diagnosis and treatment of arrhythmias in the future.Keywords: Horses, arrhythmia, high density endocardial mapping, 3D-electroanatomical mapping

Assessment and intra-observer variability of equine left atrial volume using 4D Manual LVQ algorithm (GE Healthcare).

F.C.F. Worsman, K. Blissitt, D.J. Shaw, and J.A. Keen

The Royal (Dick) School of Veterinary Studies, University of Edinburgh, Roslin, Midlothian EH25 9RG

Volume estimation by two-dimensional echocardiography (2DE) relies on geometric assumptions; three-dimensional echocardiography (3DE) does not rely on such assumptions and may allow more accurate assessment of left atrial volume. To determine the intra-observer

variability of equine left atrial volume measurement using a 3DE software analysis package. Graded datasets of the left atrium from athletic Thoroughbreds horses (n=24; 4-9yrs; 411-534kg), using a Vivid E9 with 3V transducer (GE Healthcare) were retrospectively analysed. Selection criteria excluded horses with grade >3/6 cardiac murmurs. Random generated order measurements were obtained by a single observer on 4 occasions. Real-time three-dimensional end-systolic (ESV) and end-diastolic (EDV) left atrial volumes were measured using the 4D Manual LVQ function *v. 202* (EchoPAC, GE Healthcare). Intra-observer variability was assessed via calculation of 1 - the intra-class correlation coefficient (ICC) from random-effect linear models on EDV and ESV with horse added as the random effect (1-ICC_{horse}) in R (v 3.5.2) using the *lmer* and *sjPlot* packages. Average EDV was 593.1ml (range 349-1029ml) while ESV was 381ml (range 200-695ml), n=24. Lower observer variation (1-ICC_{horse}) for ESV measurements was observed (16%) compared to EDV (23%). There was good agreement between measurements (1-ICC_{horse} <25%). 4D Manual LVQ software is a quick, effective and practical tool for obtaining left atrial volume. Error contributing to variation may include EDV/ESV time points, endocardial marker positioning and manual adjustment of the semi-automatic surface recognition. Results may improve with refined measurement guidelines. Key words: Cardiology, echocardiography, left atrial volume

ABSTRACT SESSION 5
SATURDAY 22ND NOVEMBER 11.45-12.45

Diagnostic value of the Pulmonary Artery Distensibility Index in Horses with Pulmonary Hypertension

Alessio Ferraro, Colin C. Schwarzwald

Clinic for Equine Internal Medicine, Equine Department, Vetsuisse Faculty, University of Zurich, Zurich, Switzerland

Pulmonary hypertension (PHT) can develop in horses secondary to cardiac or respiratory diseases. Non-invasive diagnosis of PHT is achieved using echocardiography. An increased pulmonary artery diameter (PAD) is suggestive for PHT. However, definitive Doppler confirmation of increased intracardiac pressure gradients requires presence of tricuspid (TR) or pulmonic regurgitation (PR).

The purpose of this study was to investigate the pulmonary artery distensibility index (PADI), quantifying the percent change in PAD during a cardiac cycle, for diagnosis of PHT in horses.

37 healthy horses, 94 horses with TR or PR and normal intracardiac pressure gradients, and 40 horses with PHT were chosen from the echocardiography database. PAD and PADI were measured and compared between groups using ANOVA and Tukey's post-hoc test. Receiver operating characteristic curves served to determine the cut-off for diagnosis of PHT. The alpha-level was 0.05.

Horses with PHT had significantly larger PAD (7.21±0.99cm; mean ±SD) and smaller PADI (14.51±7.89%) than healthy horses (6.71 ±0.64cm; 20.56±4.22%) and horses with TR or PR but no PHT (6.84 ±0.68cm; 18.61±4.81%). At a cut-off of 7.7cm, PAD predicted PHT with a sensitivity (Sn) of 32% and a specificity (Sp) of 92% (AUC=0.604, p=0.048). At a cut-off of 15%, PADI predicted PHT with Sn=50% and Sp=89% (AUC=0.687, p=0.0003).

PAD and PADI were moderately specific but not very sensitive to diagnose PHT in horses. Hence, PADI may be used as a complementary index to diagnose PHT but cannot replace Doppler confirmation of PHT in the absence of valvular regurgitation.

Key words: Pulmonary hypertension; Echocardiography; Pulmonary artery; Tricuspid regurgitation; Pulmonic regurgitation.

The Effect of Endurance Training on Left and Right Cardiac Size and Function in Horses

Dominique De Clercq, Annelies Decloedt, Bo Goovaerts, Sofie Ven, Gunther van Loon

Equine Cardioteam, Department of Large Animal Internal Medicine, Ghent University, Merelbeke, Belgium

In human medicine right and left heart changes are well documented in endurance athletes and have been associated with arrhythmias and sudden death. No information is available about the effect of endurance training on the right heart of horses. The objective was to evaluate the effect of endurance training on left and right cardiac size and function. Two-dimensional, M-mode and speckle tacking echocardiography was performed in 22 competing and 23 show Arabian horses. Systolic and diastolic right ventricular internal diameter (RVID), left ventricular internal diameter (LVID), right ventricular area (RVA) and left ventricular area (LVA) were significantly increased in the competing group. Left ventricular fractional area change (LVFAC) and right ventricular fractional area change (RVFAC) were not significantly different. Ratios that compared the dimensions of the right heart to those of the left, showed no disproportionate change of RVID or RVA. Pulmonary artery diameter increased significantly. Longitudinal systolic strain and strain rate of the mid lateral right ventricular free wall were significantly higher in the competing group. No other segmental strain or strain rate values, nor global or average segmental strain showed significant changes. The increase in internal diameters and area is consistent with the hypothesis of an eccentric cardiac hypertrophy in endurance trained horses. No functional changes were detected, except for a higher longitudinal strain and strain rate in one right ventricular myocardial segment. The right heart showed eccentric hypertrophy but was not disproportionately more enlarged than the left heart. Key words: echocardiography, speckle tracking, competition, eccentric cardiac hypertrophy, heart enlargement

First Successful Applications of Closed Loop Stimulation Pacemakers with Remote Monitoring in Two Syncopal Miniature Donkeys

Lisa De Lange[1], Glenn Van Steenkiste[1], Lisse Vera[1], Dominique De Clercq[1], Annelies Decloedt[1], Kristel M.C. Cromheeke[2] and Gunther van Loon[1]

[1]Equine Cardioteam Ghent University, Department of Large Animal Internal Medicine, Faculty of Veterinary Medicine, Merelbeke, Belgium; [2]Anegria, VZW donkey Sanctuary

Advanced second or third-degree atrioventricular (AV) block can be treated by pacemaker implantation. Pacemaker rate-adaptability has typically been obtained by a built-in accelerometer. Closed-loop (CLS) stimulation is a new rate adaptive technology which is based on myocardial impedance changes due to altered sympathetic tone, and achieves a rate-adaptation closer to physiological needs. Automatic remote monitoring allows daily wireless based exchange of pacemaker functional parameters between the patient and an online server, which automatically sends warning messages to the clinician in case of suboptimal pacemaker function. Both CLS and remote monitoring have not yet been investigated in veterinary medicine so far. In two miniature donkeys with symptomatic AV block, a rate-adaptive single chamber pacemaker with accelerometer, CLS and remote monitoring functionality (Eluna 8 SR-T, Biotronik) was implanted. A bipolar steroid eluting screw-in lead in the right ventricular apex was connected to the pacemaker. After full recovery, rate-adaptivity was assessed. In contrast to periods where no physical activity was present, during low-level exercise, increases in heart rate could be obtained with both the accelerometer and CLS function. During periods of stress, without any physical activity, only the CLS function produced physiological heart rates. With a receiver nearby the donkey (<4m distance), successful wireless remote monitoring was obtained in both cases with exchange of data to the clinician.

CLS functionality successfully allowed to achieve physiologically-paced heart rate adaptation in relation to actual needs. It also resulted in rate response without physical motion. Remote monitoring allowed automatic reporting of pacemaker function which facilitate follow-up.

Keywords: Third degree atrioventricular block, advanced, high grade, syncope, collapse

Plasma Iron Concentration and Systemic Inflammatory Response Syndrome (SIRS) in Neonatal Foals

Júlia Sanmartí[1], Lara Armengou[1, 2], Judit Viu[1, 2], Jose Ríos[3], Eduard José-Cunilleras [1, 2]

[1] Unitat Equina–Fundació Hospital Clínic Veterinari, Universitat Autònoma de Barcelona, Bellaterra, Spain;[2] Department de Medicina i Cirurgia Animals, Universitat Autònoma de Barcelona, Bellaterra, Spain; [3] Unitat de Bioestadística, Facultat de Medicina, Universitat Autònoma de Barcelona, 08193-Bellaterra, Barcelona, Spain

In equine adults iron is a sensitive marker of systemic inflammation. The aim of our study was to determine plasma iron concentration in healthy equine neonates, to assess its utility as an early inflammatory marker to predict Systemic Inflammatory Response Syndrome (SIRS) and its prognostic value in sick foals. Plasma iron was determined by colorimetric assay (Olympus AU400, Hamburg, Germany) in 225 neonatal foals (<14 days). Foals were divided in three groups: SIRS, non-SIRS and healthy controls. SIRS was defined as two or more of the following: (1) hyper- or hypothermia (rectal temperature >39.2°C or < 37.2°C), (2) leukocytosis or leukopenia (peripheral white cell count > 12.5 x 10^3/μL or < 4 x 10^3/μL), or >10% immature (band) neutrophils, (3) tachycardia (> 120 beats/min), and (4) tachypnea (> 30 breaths/min). In the studied population, the physiologic plasma iron concentration in healthy equine neonates had a wide range. Mean (95% CI) plasma iron concentration were 182 (59-305), 193 (139-247), 172 (126-220) μg/dL in controls, sick non-SIRS and sick SIRS foals, respectively. Iron did not seem to be a useful marker to predict SIRS in neonates and did not have a prognostic value in those patients. Subjectively, plasma iron concentrations appeared to progressively decrease with increasing age, therefore age specific reference ranges should be considered. After birth, several adaptations occur with erythrocytes, haemoglobin and iron metabolism, therefore looking for alternative inflammatory markers could be more useful in equine neonatal medicine. Key words: neonates; SIRS; iron; inflammatory markers.

ABSTRACT SESSION 6
SATURDAY 22ND NOVEMBER 11.45-12.45

Frequent Occurrence of Equine Hepatitis-Associated Virus Infections in Austrian Horses

Marcha Badenhorst[1], Phebe de Heus[1], Angelika Auer[2], Till Rümenapf[2], Birthe Tegtmeyer[3], Eike Steinmann[4], Norbert Nowotny[2], Jessika-M.V. Cavalleri[1]

[1] University Equine Clinic - Internal Medicine, Department for Companion Animals and Horses, University of Veterinary Medicine (Vetmeduni), Vienna, Veterinärplatz 1, 1210, Vienna, Austria. [2] Institute of Virology, University of Veterinary Medicine (Vetmeduni), Vienna, Veterinärplatz 1, 1210, Vienna, Austria. [3] Institute for Experimental Virology, TWINCORE Centre for Experimental and Clinical Infection Research, Medical School Hannover (MHH) – Helmholtz Centre for Infection Research (HZI), Feodor-Lynen-Strasse 7, 30625, Hannover, Germany. [4] Department of Molecular and Medical Virology, Ruhr-University Bochum, 44801, Bochum, Germany.

Equine hepacivirus (EqHV) and equine parvovirus-hepatitis (EqPV-H) are novel viral agents associated with hepatitis in horses. EqHV has been detected in horse populations globally, including countries neighbouring Austria. EqPV-H was first reported in 2018 in the USA. Its prevalence outside the USA and China remains unknown.

EqHV and EqPV-H haven't been reported in Austria. Investigating these viruses' prevalence and associated serum biochemistry changes would enhance local equine practitioners' understanding of the viruses' potential importance in hepatitis cases.

Serum samples were collected from 386 horses in eastern Austria between July and October 2017 for surveillance purposes. Sampled horses included patients of the Vetmeduni Equine Clinic (n=58), training horses of the Vetmeduni (n=50) and privately-owned, clinically healthy horses enrolled voluntarily (n=278). Samples were analysed for anti-EqHV non-structural (NS)3-specific antibodies by luciferase immunoprecipitation system (LIPS) and for EqHV RNA by quantitative real-time polymerase chain reaction (qRT-PCR). Additionally, 247 of

these samples were analysed for EqPV-H DNA by nested PCR. GLDH, GGT, bile acids and albumin were measured in all PCR-positive samples, as well as in samples from PCR-negative, clinically healthy control horses (n=45).

EqHV seroprevalence of 45.9% (177/386) and EqHV RNA prevalence of 4.1% (16/386) were within reported ranges. EqPV-H DNA prevalence was 8.5% (21/247). One horse was co-infected with both viruses.

EqHV PCR-positive horses had significantly higher GLDH levels ($P<0.05$), compared to both EqPV-H PCR-positive horses and healthy control horses.

In conclusion, EqHV and EqPV-H are present in the Austrian horse population and should be considered as differential diagnoses in hepatitis cases.

Keywords: viral hepatitis; liver; equine hepacivirus (EqHV); non-primate hepacivirus (NPHV); hepacivirus A; equine parvovirus-hepatitis (EqPV-H); Austria.

Equine Coronavirus enteric disease outbreak in Austria

Hannah Junge[1]*, Angelika Auer[2]*, Till Rümenapf[2§], Jessika-M.V. Cavalleri[1§]

[1]Equine Clinic, University of Veterinary Medicine, Vienna, Austria.
[2]Institute of Virology, University of Veterinary Medicine, Vienna, Austria.
*, § equal contributions

Equine Coronavirus (ECoV) a betacoronavirus is a known, yet rare enteric pathogen of adult horses. Outbreaks have been reported in the USA and Japan. Here, a descriptive study investigated the clinical, serologic and virologic aspects of an outbreak of ECoV in Austria. Between February and April 2018 six cases of ECoV infection in hospitalised patients originating from 5 facilities were confirmed. 48 of 187 contact horses at the originating farms were diagnosed with ECoV infection. Clinical signs included fever, lethargy, anorexia, colic and/or diarrhoea. Faecal (qRT-PCR) and serologic samples (ELISA and indirect immunofluorescence) were analysed. Cases presented to the teaching hospital comprised horses aged one to seventeen years and of different breeds (Icelandic, Frisian, Norwegian horse, Haflinger, Noriker). All showed gastrointestinal signs. Laboratory workup revealed signs consistent with inflammation and gastrointestinal disease. Faecal samples did not reveal other causative pathogens than ECoV. All horses recovered but two showed prolonged shedding (4 and 10 weeks). Out of 79 horses at the facility the Icelandic horse originated from 26% showed clinical signs consistent with ECoV infection with PCR-confirmed infection in 43/79. All despite two horses recovered and cleared the virus not later than week 13. A raise in antibody titer could be demonstrated in 5/11 horses. Consecutive outbreaks after contact with infected horses stress the viruse's infectious potential. In conclusion, enteric disease caused by ECoV was found in horses with epidemic character in Austria. The infection spreads rapidly and should be considered as a differential diagnosis when compatible clinical signs exist.

Key-words: Equine coronavirus, outbreak, GI disease

Serology For *Streptococcus Equi* May not be Valuable for Identification of Long-Term Carrier Status in Horses.

Mark Bowen[1], Carolyn Bates[2], Abigail Morgan[1], Caroline Bullard[3], Harriet Telfer[4], Nicola Housby Skeggs[5], Suzy Palfreman[1], Emma Peal[2], Gayle Hallowell[1].

[1] School of Veterinary Medicine and Science, University of Nottingham; [2] Defence Animal Training Regiment, Melton Mowbray; [3] The Kings Troop Royal Horse Artillery, Woolwich; [4] Household Cavalry Mounted Regiment, Knightsbridge; [5] The Horse Trust, Princes Risborough

Serology is commonly used in practice to identify carriers and active infections in horses with *Streptococcus equi*. The aim of this retrospective study is to evaluate serological results in horses in established populations with chondroids and compare with in-contacts. Data was obtained from herds where routine evaluation for *S. equi* is undertaken. Blood and guttural pouch washes were submitted to commercial laboratories based on location and were analysed the day after collection. Ten horses were identified with chondroids and all were found to have low *S. equi* serology titres for antigen A (Median=0.25 (IQR=0.125-0.3);Range=0.1-0.5) and C (Median=0.2;IQR=0.1-0.2; Range=0-0.4) where only 1 horse for each antigen would have been identified as borderline or positive (titre>0.3). Five of these horses were culture or PCR positive for *S. equi* (either from chondroid or guttural pouch wash, all with A and C titres <0.3), two were culture positive for *S. zooepidemicus* (both with a titre >0.3 for antigen A or C) and two were negative on culture or PCR. The serology titres were not different for in-contact horses (n=35) that were PCR negative on pooled GP washes for *S. equi* (Antigen A: Median=0.2 (IQR=0.15-0.45; Range=0.1-1.6; p=0.76); Antigen C: Median=0.1 (IQR=0.1-0.3; Range=0-0.7; p=0.68)). Of these in-contacts, 29% and 26% had titres >0.4 for antigen A and C, respectively, suggesting ongoing exposure. This modest study suggests that use of serum titres may not be valuable to identify horses that have likely had long-term carrier status and chondroids and warrants further work.

Key words: Strangles, ELISA, equine.

Eosinophilic Asthma in Sporthorses

C.M. de Bruijn[1], B. Boshuizen[1,2] , M.A. Swierstra[3], C.W. Westermann[3] and C.J.G.Delesalle[2]

[1] Wolvega Equine Hospital, Oldeholtpade, the Netherlands [2] Department of Virology, Parasitology and Immunology, Division of Comparative Physiology, Ghent University, Belgium [3] Department of Equine Sciences, Utrecht University, Utrecht, the Netherlands

In order to identify typical clinical features of eosinophilic asthma in sporthorses a retrospective study was performed in 147 Standardbreds and 123 Warmblood sporthorses diagnosed with IAD. Horses with a clear positive tracheal wash culture or with RAO were excluded. Horses were subjected to respiratory endoscopy (grading mucus and blood), tracheal wash and broncheoalveolar lavage (BAL). The prevalence of eosinophilic IAD was higher in the Standardbred population compared to Warmbloods (p=0.001 Chi-square, p=0.002 bi-log regression). An increase of eosinophils in the BALF (>1%) of

Standardbreds or Warmbloods was more often associated with a normal cell count of neutrophils in the BALF (p=0.04 Chi-square and p=0.004 resp.). Eosinophilic IAD was more prevalent in Warmblood horses <5 years (p= 0.01 Chi-square) compared to >5years. In the Standardbred population there was no age difference. Increase of eosinophils was, in contrast to neutrophils, not associated with cough nor increased mucus score. This study suggests eosinophilic IAD may be exercise related comparable to nonallergic eosinophilic asthma in humans[1]. This is in accordance with Hare[2] suggesting eosinophilic IAD in racehorses is of non-allergic origin and associated with racing and airway hyperresponsiveness. A follow-up study in which Standardbreds that do not race are compared to racing Standardbreds might clarify this hypothesis.

Keywords
Non-allergic eosinophilic asthma

References:

1. Helenius I, Haahtela T. Allergy and asthma in elite summer sport athletes. *J Allergy Clin Immunol*. 2000;106(3):444-452

2. Hare JE, Viel L. Pulmonary eosinophilia associated with increased airway responsiveness in young racing horses. *J Vet Intern Med*. 1998;12(3):163-170

RESEARCH ABSTRACTS POSTER PRESENTATIONS

Metabolic Perturbations in Horses with Pituitary Pars Intermedia Dysfunction (PPID).

Agnieszka Żak[1], Natalia Siwińska[1], Malwina Słowikowska[1], Jacek Wilczak[2], Adam Prostek[2], Amanda A Adams[3], Artur Niedźwiedź[1]

[1]Department of Internal Medicine and Clinic of Diseases of Horses, Dogs and Cats, Faculty of Veterinary Medicine, Wroclaw University of Environmental and Life Sciences, pl. Grunwaldzki 47, 50-366 Wroclaw, Poland, [2] Department of Physiological Sciences, Faculty of Veterinary Medicine, Warsaw University of Life Sciences, Warsaw, Poland, [3]M.H. Gluck Equine Research Center, Department of Veterinary Science, University of Kentucky, Lexington, Kentucky

Equine Pituitary Pars Intermedia Dysfunction (PPID) is a neurodegenerative disease caused by a lack of dopaminergic stimulation of the pituitary gland that mainly affects older horses. The overproduction of ACTH and formation of macro- or microadenomas in the pituitary pars intermedia can cause typical clinical signs like hipertrichosis, loss of muscle mass, behavioural changes, lethargy, polyuria, polydipsia and laminitis. Metabolic perturbations in PPID may be better understood by applying metabolomic analysis of small-molecule metabolites that may be involved in the disease process.

Twenty senior horses diagnosed with PPID (mean 23,3 ±4,6 years) and six age-matched healthy senior horses diagnosed as non-PPID (mean 22,0 ±2,2 years) were used in this study. Metabolomic analysis was performed on plasma samples, using Quadrupole time-of-flight mass spectrometry. Statistical analysis was performed by the Student t-test and PCA analysis (MarkerView™).

Differences between metabolomes in both groups (P<0,05) were shown in case of 249 metabolites. Metabolites that differentiated the metabolomes in the studied groups belonged to the pathways: vitamin D3 metabolism (i.e. calcidiol, calcitriol, provitamin D3, vitamin D3); glycerophospholipid metabolism (i.e. CDP-choline, sphingamine, cholesterol) and valine, leucine and isoleucine degradation (according XCMSplus and MataboAnalyst 4,0). Four metabolites with unknown mechanisms were also identified and will be further explored. Use of metabolomics could provide new knowledge about pathophysiology of metabolic perturbation in case of neurodegeneration causing endocrine disorders in horses and may have diagnostic utility for early detection of PPID.

Key words: Metabolomics, neurodegeneration, horses, pituitary pars intermedia dysfunction

Treatment of equine glandular gastric disease in elite endurance horses with oral and long-acting injectable omeprazole: a randomised, blinded clinical trial

Rendle, D.I.

Rainbow Equine Hospital, Malton, North Yorkshire, United Kingdom

Objectives: To compare the efficacy of oral (ORL) and long-acting-injectable-omeprazole (LAIO) in the treatment of equine glandular gastric disease (EGGD) in a population of elite endurance horses.

Methods: 99 horses diagnosed with EGGD of grade ≥2/4 on gastroscopy were assigned randomly to receive 4 mg/kg bwt ORL SID for 28 days (44 horses) or 4 doses of 4mg/kg bwt LAIO IM at 7-day intervals (45 horses). Horses were weighed weekly and doses adjusted accordingly. Gastroscopic examination was repeated after 28 days by a clinician blinded to treatment allocation. Lesions of the pyloric antrum, fundus and cardia were described as proposed previously (Sykes et al. 2015) and were also graded (0-4) before and after treatment. Resolution was defined as grade 0, glandular mucosa with a normal healthy appearance.Results: The rate of EGGD resolution was higher in the LAIO group (19/45, 42%) than the ORL group (5/44, 11%), p = 0.001. Fewer horses in the LAIO group (14/45, 31%) required further treatment than in the ORL group (27/44 ,61%), p= 0.004. Discussion: Rates of healing with both treatments were lower than reported previously, which may be due to management factors. EGGD healed in four times as many horses treated with LAIO compared to oral omeprazole and half as many in the LAIO group required further treatment. Conclusions and clinical significance: LAIO was more effective than oral omeprazole in treating EGGD in this population of elite performance horses and be a more efficacious treatment in other populations.

Reference: Sykes, B.W., Hewetson, M., Hepburn, R.J., Luthersson, N. and Tamzali, Y. (2015) European College of Equine Internal Medicine Consensus Statement--Equine Gastric Ulcer Syndrome in Adult Horses. *J Vet Int Med* **29**, 1288–1299.

Treatment of equine squamous gastric disease in elite endurance horses with oral and long-acting injectable omeprazole: a randomised, blinded clinical trial

Rendle, D.I.

Rainbow Equine Hospital, Malton, North Yorkshire, United Kingdom

Objectives: To compare the efficacy of oral (ORL) and long-acting-injectable-omeprazole (LAIO) in the treatment of equine squamous gastric disease (ESGD) in a population of elite endurance horses.
Methods: 100 horses diagnosed with ESGD of grade ≥2/4 on gastroscopy were assigned randomly to receive 4 mg/kg bwt ORL SID for 28 days (49 horses) or 4 doses of LAIO IM at 4mg/kg bwt at 7-day intervals (51 horses). Horses were weighed weekly and doses adjusted accordingly. Gastroscopic examination was repeated after 28 days by a clinician blinded to treatment allocation. Lesions of the squamous mucosa were graded according to an accepted 0-4 scale (Sykes et al. 2015) before and after treatment. Resolution was defined as grade 0. Results: The rate of ESGD resolution was higher in the LAIO group (40/51, 78%) than the ORL group (9/49, 18%), $p < 0.001$. Fewer horses in the LAIO group that required further treatment (6/51, 12%) than in the ORL group (30/49, 60%), $p < 0.001$.
Discussion: The rate of healing with ORL was lower than reported previously which may be due to management factors. ESGD healed in four times as many horses with LAIO. Horses treated with ORL were 5 times as likely to require further treatment. Conclusions and clinical significance: LAIO was more effective than ORL in treating ESGD in this population of elite endurance horses and may be a more efficacious treatment in other populations.
Reference:
Sykes, B.W., Hewetson, M., Hepburn, R.J., Luthersson, N. and Tamzali, Y. (2015) European College of Equine Internal Medicine Consensus Statement--Equine Gastric Ulcer Syndrome in Adult Horses. *J Vet Int Med* **29**, 1288–1299.

The Effect of Dietary Manipulation on Plasma Adiponectin Concentrations

Nicola Menzies-Gow[1], Clare Barfoot[2], Patricia Harris[3]

[1]Department of Clinical Sciences and Services, Royal Veterinary College, North Mymms, UK; [2]MARS Horsecare UK Ltd, Milton Keynes, UK; [3]Equine Studies Group, Waltham Centre for Pet Nutrition, Waltham-on-the-Wold, UK

Hypoadiponectinaemia, an additional feature of the equine metabolic syndrome (EMS), is associated with an increased risk of developing laminitis. In human metabolic syndrome (HMS), dietary manipulation may help improve some HMS features, including hypoadiponectinaemia and endothelial dysfunction, and thereby reduce the associated cardiovascular disease risk. This study aimed to determine whether circulating adiponectin concentrations could be increased in EMS ponies through similar dietary manipulation without weight loss. Twelve British native breed ponies (mean±SD 284±66 Kg; 18±5 years; all mares) with EMS (increased basal insulin &/or an abnormal oral sugar test [OST]) were fed two diets (pasture alone or 70% low Non-structural-carbohydrate (NSC) [<10%] hay plus 30% low NSC [12%] high-fibre feed [Spillers SPEEDY-MASH] supplemented with linseed oil [0.16ml/Kg] and a source of omega 3 fatty acids [36g/pony/day Docosahexaenoic Acid]), each for 4 weeks, in a randomised cross-over design with a two week wash-out period at pasture between diets. Blood samples were obtained and an OST (0.45ml/Kg corn syrup) performed on days 0 and 28 of each 4-week diet. Plasma adiponectin and triglyceride plus serum insulin concentrations were measured using validated assays. Bodyweights remained constant. Whilst there was a significant ($p=0.001$) effect of the individual pony on plasma adiponectin concentration, there was no effect of diet. There was also no effect of diet on any of the other variables measured. Therefore, feeding a low NSC diet high in omega 3 fatty acids and linseed oil did not result in an increase in circulating plasma total adiponectin concentrations.
Key words: Adiponectin, insulin, diet

ECA-MIR-331 Is Upregulated In Serum Of Horses And Donkeys With Skin Tumors

L. Unger[1], C. Abril[2], V. Gerber[1], V. Jagannathan[3], C. Koch[1], E. Hamza[1]

[1] Swiss Institute of Equine Medicine, Department of Clinical Veterinary Medicine, Vetsuisse Faculty, University of Bern, Switzerland. [2] Institute of Virology and Immunology, University of Bern, Switzerland. [3] Institute of Genetics, Vetsuisse Faculty, University of Bern, Switzerland

Using next generation sequencing we have previously shown that eca-miR-331, -100, and -1 were differentially expressed microRNAs (miRNAs) in serum of sarcoid- affected vs control horses. The aim of the current study was to validate the identified candidate miRNAs as serum biomarkers for equine sarcoid (ES) disease in a larger cohort study composed of horses and donkeys with sarcoids and controls with or without other types of skin tumors by qRT-PCR. MiRNAs were extracted from serum of ES-affected horses (n = 56) and donkeys (n = 13), control horses (n = 60) and donkeys (n = 9), and horses with other skin tumors (melanoma, squamous cell carcinoma) (n = 20). Hemolysis in serum samples was evaluated using the hemolysis index (Cobas 6000). The extracted miRNAs were subjected to qRT-PCR with primers specific for eca-miR-331, -100, and -1. Statistical analysis of variance showed no effect of breed, age, or gender on expression of the examined miRNAs. Hemolysis did not influence the expression of eca-miR-331. In contrast, the other two candidate miRNAs were significantly influenced by hemolysis. As in the pilot study, there was a significant upregulation of eca-miR-331 in ES-affected equids compared to control equids without tumors. A statistically significant difference in miRNA expression for eca-miR-100 and -1 in ES-affected vs control animals could however not be confirmed. Eca-miR-331 was also upregulated in serum of horses with other skin tumors, suggesting a role of this miRNA as a biomarker for equine skin tumors in general not only restricted to equine sarcoids.
Keywords: microRNA, biomarker, equine sarcoid disease, equine skin tumors

Outcome of an intravitreal injection of a microdose of gentamicin for treatment of ERU and association with Leptospiral status in the west of France

Tanguy Hermange[1,2], Anne Courouce[1,2]

[1] Unité de nutrition, PhysioPathologie et Pharmacologie (NP3), Ecole nationale vétérinaire, agro-alimentaire et de l'alimentation Nantes-

Atlantique (Oniris), Université Bretagne Loire (UBL), Nantes F-44307, France; [2]CISCO (Centre International du Cheval d'Oniris), Ecole nationale vétérinaire, agro-alimentaire et de l'alimentation Nantes-Atlantique (Oniris), Nantes F-44307, France

The use of an intravitreal injection of a microdose (4 mg) of gentamicin is increasing by equine practitioner in ERU cases. Our study aims to evaluate the association between the outcome of an intravitreal injection of a microdose of gentamicin and leptospiral-ERU status. To assess leptospiral status, both a Leptospiral microscopic agglutination titres ratio between aqueous humour and serum (C-value) superior to 4, or a positive Leptospiral polymerase chain reaction (PCR) on aqueous humour, were used. All the horses were followed up for at least 12 months. As a complete ophthalmologic exam was not available for each horse during the follow up, only horses with easily recognizable active signs of ERU by the referring vet and/or owner were included in this study (insidious ERU excluded). A total of 19 horses were included. Regarding leptospiral-associated ERU status, 58% (11/19) were positive and 42% (8/19) were negative. On short term, all horses responded well to intravitreal injection without any recurrence during the first 6 months. The majority (10/11) of horses positive to leptospiral-ERU did not showed any signs of recurrence for at least 12 months. On the other side, 4/8 horses with non-leptospiral ERU showed some signs of partial response after 6 months with either recurrence or signs of active insidious form of ERU. These preliminary results suggest that good short-term outcome observed with intravitreal injection of microdose of gentamicin is not dependent on leptospiral-ERU status. However, the leptospiral-ERU status may influence long term outcome.

Key words: equine recurrent uveitis (ERU), leptospirosis, intravitreal injection, microdose of gentamicin

Respiratory Gene Technology ® and Serum as Treatment for Mild Equine Asthma in Racehorses

Sanni Hansen[1], Louise Laustsen[2], Charlotte Hopster-Iversen[1], Rune Bech[1], Simon Byrgesen[1], Julie Fjeldborg[1]

[1]Department of Veterinary Clinical Sciences, Faculty of Health and Medical Sciences, University of Copenhagen[2]ScanVet Animal Health A/S, Kongevejen 66, DK-3480 Fredensborg

Alternative treatment options to glucocorticoids for equine asthma is desirable due to withdrawal time and risk of laminitis.

The aim of this study was to evaluate if serum and RGT (Respiratory Gene Technology), a commercial kit to produce autologous conditioned serum, were effective in reducing bronchoalveolar lavage (BAL) neutrophils and mast cells in racehorses with cytological evidence of mild equine asthma (MEA).

Thirty-six thoroughbred racehorses in active training were enrolled in the study; a control group (n=11) with normal BAL values, a RGT (n=12) and a serum treatment group (n=13). An endoscopy including BAL was performed before (T0), after a six-week treatment period including 12 intramuscular injection of RGT or serum (T6) and as a follow-up 10 weeks after last treatment (T16).

No difference between any of the time point was found for the control group. A significant decrease in BAL neutrophils (RGT $p<0.01$; serum $p<0.01$) and mast cells (RGT $p=0.02$; serum $p<0.01$) was found for both treatment groups between T0 and T6. A significant difference between T0 and T16 was found for BAL neutrophils in the serum treatment group ($p=0.05$) and BAL mast cell groups (RGT $p<0.01$; serum $p=0.03$). No difference was found between T0 and T16 for BAL neutrophils for the RGT group ($p=0.49$).

Preliminary results from this study showed that intramuscular treatment with either RGT or serum was effective in reducing BAL neutrophils and mast cells in horses with MEA. Further studies are necessary to evaluate the long-term effects as well as comparison to other treatment options.

Bacterial Culture of Tracheal Aspirate or Long Tissue of 76 Foals Presented with Clinical Signs of Pneumonia

Zoé Neuckermans, Ellen Paulussen, Alexander Dufourni, Laurence Lefère, Gunther van Loon

Department of Large Animal Internal Medicine, Ghent University, Merelbeke, Belgium

Streptococcus equi subsp. *zooepidemicus* (Strep-zoo) and *Rhodococcus equi* (*R.equi*) are the most common bacterial isolates in foals with pneumonia during the first months of life, but little is reported about their relative frequency of occurrence. The aim of this retrospective study was to discuss the results of bacterial culture of tracheobronchial aspirates or lung tissue (necropsy) of foals presented with clinical signs of pneumonia including depression, fever, cough, nasal discharge and dyspnoea. Bacterial culture issued from 76 foals aged between 0 and 365 days presented between January 2009 and December 2018 at our referral hospital were reviewed. Strep-zoo and *R.equi* were isolated in 35.5 % (27/76) and 22.4% (17/76), respectively. Two samples were positive for both pathogens. Other bacterial isolates were *Actinobacillus spp*. (n=5), *Pseudomonas spp*. (n=3), *E.Coli* (n=2), *Klebsiella spp*. (n=1), *Bordetella spp*. (n=1), *Staphylococcus spp*. (n=1) and *Streptococcus equi subsp. equi* (n=1). Survival to discharge was higher in de Strep-zoo group (81.5%,22/27) compared to the *R.equi* group (64.7%,11/17). Foals with Strep-zoo infection were older (mean 129 days) compared to those with R.equi (mean 59 days). Lung abscesses were found on ultrasound in 37% (10/27) of the Strep-zoo cases and in 76% (13/17) of the *R.equi* cases. In conclusion, in our hospital population Strep-zoo was more prevalent than *R.equi*. Age and abscess formation might be suggestive for the causative pathogen. However, proper diagnosis by bacterial culture is essential to avoid unnecessary use of critical antibiotics and to better define prognosis.

Key words: equine; bacterial isolates; Streptococcus zooepidemicus; Rhodococcus equi.

Semi-Automatic Segmentation and Tracking of the Left Ventricle in Healthy Horses and Horses with Severe Aortic Valve Regurgitation Using an Optical Flow-Based B-Spline Explicit Active Tracking of Surfaces (ofBEATS) Method.

Dominique De Clercq[1], Glenn Van Steenkiste[1], Lisse Vera[1], Yordi Verhoeven[1], Annelies Decloedt[1], Joao Pedrosa[2], Jan D'Hooge[2], Gunther van Loon[1]

[1]Equine, Cardioteam, Department of Large Animal Internal Medicine, Ghent University, Merelbeke, Belgium [2]Department of cardiovascular sciences, Catholic University of Leuven (KU Leuven), Leuven, Belgium

In human medicine, optical flow-based B-spline explicit active tracking of surfaces (ofBEATS) is a semi-automatic segmentation and tracking technique for determination of the left ventricular diameter, length, area and curvature and is used for volumetric assessment. The objective was to evaluate the use of ofBEATS in normal horses and horses with severe aortic valve regurgitation. ofBEATS was applied on the left ventricle in a four chamber view image of 15 normal horses and 12 horses with severe aortic valve regurgitation. The end-diastolic mean ± standard deviation length, basal diameter, apical diameter, total area and apical curvature in the normal horses and horses with severe aortic valve regurgitation were 17.6±1.9 cm, 12.5±1.3 cm, 7.1 ±0.8 cm, 170.3±28.5 cm^2, 25.5±3.4 cm^{-1} and 19.9±2.0 cm, 15.0 ±1.9 cm, 9.3±2.1 cm, 237.8±53.4 cm^2, 19.8±3.7 cm^{-1}, respectively. The mean length, basal (20% of total length from mitral valve annulus), apical diameter (20% of the total length), total area and apical curvature at end-systole in the normal horses and horses with severe aortic valve regurgitation were 12.6±1.5 cm, 9.7±1.4 cm, 3.1±1.0 cm, 82.9 ±14.8 cm^2, 85.0±98.8 cm^{-1} and 14.8±3.1 cm, 11.8±2.3 cm, 5.1 ±2.8 cm, 131.1±57.7 cm^2, 41.4±18.5 cm^{-1}, respectively. All measurements, except the end-systolic curvature value, were significantly different in the horses with severe aortic valve regurgitation. ofBEATS can be used in equine echocardiography. Besides differences in left ventricular size and area it also allowed objective quantification of left ventricular apical curvature which was significantly different in horses with severe aortic valve regurgitation.

Key Words: quantification, size, shape, speckle tracking, curvature

Changes in the Metabolomics Profile of Horses with Clinical Kidney Dysfunction – Preliminary Study

Natalia Siwinska[1], Agnieszka Zak[1], Malwina Slowikowska[1], Artur Niedzwiedz[1], Urszula Paslawska[1], Adam Prostek[2], Jacek Wilczak[2]

[1]Department of Internal Medicine and Clinic of Diseases of Horses, Dogs and Cats, Faculty of Veterinary Medicine, Wroclaw University of Environmental and Life Sciences, pl. Grunwaldzki 47, 50-366 Wroclaw, Poland, [2]Department of Physiological Sciences, Faculty of Veterinary Medicine, Warsaw University of Life Sciences, Warsaw, Poland

Metabolomics, defined as the comprehensive and quantitative analysis of all metabolites of the biological system under study, is beginning to be a promising technique in identifying new biomarkers of disease. Specific metabolic changes have been reported in renal disease. Despite the growing awareness of acute kidney injury in horses, there is still little knowledge about the possibility of using biomarkers for early detection. The aim of the study was to evaluate changes in the serum metabolomic profile of horses with diagnosed renal dysfunction compared to healthy horses.

Eleven clinically healthy horses (mean 9.3 ± 5.4 years) and 11 horses (mean 9.9 ± 6.5 years) with clinical acute kidney injury stage 2 and 3 (according to AKIN criteria for human AKI) were included in the study. Metabolomic analysis was performed on serum samples, using Quadrupole time-of-flight mass spectrometry. Statistical analysis was performed by the Student t-test and PCA analysis (MarkerView™). Differences between metabolomes in both groups (P<0,05) were demonstrated for 514 metabolites. There were significant differences between the two groups in metabolites belonging to the following pathways: vitamin D3 metabolism (e.g. calcidiol, calcitriol) and leukotriene metabolism (e.g. leukotriene B4, 20-OH-Leukotriene B4), according to XCMSplus and MetaboAnalyst 4,0. Four unknown metabolites which were significantly different in the renal group will be identified further.Use of metabolomics could further knowledge regarding the pathophysiology of kidney dysfunction in horses. Evaluations of changes in the metabolomic profile may facilitate early detection of acute kidney injury in horses with formation of biomarker profiles.

Key words: metabolomics, horses, kidney dysfunction, kidney failure, biomarker.

Comparison of Thoracic Ultrasonographic Findings Before and After Bronchoalveolar Lavage in Horses with Equine Asthma

Zoltan Bakos, Peter Miko, Szilvia Kovacs

Department and Clinic of Equine Medicine, University of Veterinary Medicine Budapest, Hungary

Bronchoalveolar lavage and thoracic ultrasonography are frequently used diagnostic methods in horses suffering from chronic lower airway diseases. The aim of our study was to investigate whether bronchoalveolar lavage affects the findings of thoracic ultrasonography. Twenty horses suffering from severe equine asthma were included in the study. Examination methods included physical examination, respiratory endoscopy, collection of bronchoalveolar lavage fluid (BALF), thoracic ultrasonography before and after bronchoalveolar lavage (BAL) and cytology of BALF. Data was analysed by descriptive statistics, Chi-square tests and correlation analysis. The distribution of comet tail artefacts was significantly different in different intercostal spaces (ICS) before BAL. The cranial intercostal spaces were more affected (left side: 5^{th} ICS: 7, 6^{th} ICS: 15, 7^{th} ICS: 10 horses had artefacts; right side: 5^{th} ICS: 16, 6^{th} ICS: 9, 7^{th} ICS: 6 animals showed this abnormality). The overall number of comet tail artefacts was significantly higher after BAL (47% increase). When hemithoraces were compared separately, the difference was also significant between before and after results. Significant differences were found in several individual ICS between before and after results (left side: 4^{th}, 5^{th}, 8^{th}, 10^{th}, and 12^{th} to 16^{th}; right side: triceps, 4^{th}, 6^{th}, 7^{th} and 10^{th} to 12^{th}). Comet tail artefacts showed a characteristic pattern before BAL, being more frequent in the cranioventral part of the thorax. BAL affected thoracic ultrasonographic findings in this study population. To avoid misinterpretation of findings, it is recommended to perform ultrasonography before bronchoalveolar lavage. Key words: Thoracic ultrasonography; Equine asthma; Bronchoalveolar lavage

Feasibility and Repeatability of Three-Dimensional Echocardiographic Analysis of Equine Left Ventricular Volume

R. C. Jago[1], J. C. Reed[1], K. Blissitt[1], L. Young[2], R. Shave[3] and J. A. Keen[1]

[1] The Royal (Dick) School of Veterinary Studies and Roslin Institute, The University of Edinburgh. [2] Specialist Equine Cardiology Services, Suffolk. [3] University of British Columbia – Okanagan

Left ventricular (LV) stroke volume is currently estimated using two-dimensional (2D) or Doppler methods. Three-dimensional (3D) echocardiography (3DE) enables volume measurements independent of geometric assumptions and plane positioning errors. This study assessed the feasibility and repeatability of equine LV volume analysis using 3DE, and compared it to analysis by Simpsons method of discs (SMOD), area-length (AL) and pulsed wave Doppler methods.

Three-dimensional datasets of the LV were acquired prospectively from 18 National Hunt Thoroughbred racehorses in training (right parasternal long axis view) using a Vivid E9 with a 4V-D transducer. Blinded to horse details and any previous results, offline 2D and 3DE analyses were performed using the same three non-consecutive cardiac cycles. One-way repeated measures ANOVA compared methods for LV estimation; coefficients of variation (CV) and Pearson's correlation coefficients were calculated to determine intra-observer measurement (repeated measurements of same examination) and acquisition (repeated acquisitions of same horse) repeatability.

Mean stroke, end-diastolic and end-systolic volumes were all significantly different comparing 3DE to all other methods (stroke volumes: 3DE 1108ml (s.d. 122), SMOD 680ml (s.d. 137), AL 723ml (s.d. 138) and Doppler 1295ml (s.d. 206)). Intra-observer measurement variability was low for all methods (CV 2.2-6.2%). Intra-observer acquisition variability was slightly greater then measurement variability, for all methods. Pearson's correlation coefficient (r = 0.90) and CV (6.8%) showed superior acquisition repeatability of 3DE. In conclusion, estimation of LV volumes by 3DE is feasible, shows greater repeatability compared to current methods, and has the potential to allow accurate longitudinal assessment of LV size.

Key words: Cardiology, Three-dimensional echocardiography, Left ventricular volume

Plasma Metabolome of Horses During Oral Glucose Tests

Julien Delarocque[1], Florian Frers[1], Klaus Jung[2], Korinna Huber[3], Karsten Feige[1], Tobias Warnken[1]

[1]Clinic for Horses, University of Veterinary Medicine Hannover, Foundation, Bünteweg 9, 30559 Hanover, Germany [2]Institute for Animal Breeding and Genetics, University of Veterinary Medicine Hannover, Foundation, Bünteweg 17p, 30559 Hanover, Germany [3]Institute of Animal Science, Faculty of Agricultural Sciences, University of Hohenheim, Fruwirthstraße 35, 70593 Stuttgart, Germany

During oral glucose tests (OGTs) horses with insulin-dysregulation (ID) show an exacerbated insulin response to a glycaemic challenge. The aim of this study was to investigate if this response is also associated with inflammatory events or other metabolic imbalances. Three OGTs were performed in twelve Icelandic horses of different metabolic status kept under similar conditions. A combined LC-MS/MS and FIA-MS/MS assay (IDQ p180, Biocrates, Innsbruck) targeting metabolites involved in a broad range of pathways was then used for metabolomic analysis of plasma samples from the time-points 0, 120 and 180 minutes. Using linear models concentrations of metabolites associated with inflammation like tryptophan and kynurenine were shown to significantly increase over time (FDR-adjusted P<0.01). In further metabolites, a linear relationship to the AUCinsulin was detected. For instance arginine, an amino acid known for its essential role in vasodilation, was found to be significantly lower in horses with higher insulin levels (FDR-adjusted P<0.05). In a reversed approach, predictive models were successfully used to demonstrate the ability of such a dataset to differentiate between horses with high and low insulin response. These results suggest that an inflammatory response was triggered during OGT independently of the insulin status of the horse. Metabolites associated with the insulin levels could be relevant to better understand the pathomechanisms of ID, as biomarkers for this disease, and as potential therapeutic targets. If these results were confirmed by further experiments, a set of these metabolites could eventually be brought to on-site diagnostic platforms. Keywords: EMS, insulin dysregulation, metabolomics, OGT

Protein Carbonyl as a Biomarker of Oxidative Stress in Sirs Horses

Irene Nocera[1], Francesca Bonelli[1], Valentina Meucci[1], Luigi Intorre[1], Riccardo Rinnovati[2], Alessandro Spadari[2], Micaela Sgorbini[2]

[1]Dipartimento di Scienze Veterinarie, Università degli studi di Pisa, Italia[2]Dipartimento di Scienze Mediche Veterinarie, Università di Bologna, Italia

The aim of this study was to evaluate the Protein Carbonyl Content (PCC) in healthy horses and horses affected by SIRS.

A total of 48 horses were included, 24 healthy and 24 sick horses referred to two veterinary teaching hospitals. Horses were evaluated as SIRS positive or negative according to a previous paper. Blood samples were collected in healthy horses only once, and at admission (T0), 24(T1), 48(T2), 72(T3), 96(T4) hours after admission in sick horses. PCC was evaluated using the method by Levine et al. Data were analyzed for distribution using the KS test and results were expressed as median ±SE. Kruskal-wallis and Dunn's multiple comparisons tests were used to verify differences between healthy and SIRS positive horses at different sampling times. P value was set at <.05. The ROC curve was performed to evaluate the best cut-off for the diagnosis of SIRS.

The 24 healthy horses presented a normal physical examination and laboratory data within reference ranges and were included in the control group. Three/24 sick horses were not positive for SIRS score and were excluded. The PCC (nmol/mL/mg) was 0.052±0.008 in healthy horses and 0.312±0.007(T0), 0.079±0.032(T1), 0.093±0.036(T2), 0.081±0.034(T3), 0.084±0.027(T4) in SIRS positive animals. Differences were obtained between healthy and SIRS positive horses at T0, T1 and T2, and in SIRS positive horses between T0 vs T72 and T96. The best cut-off found was 0.128 nmol/mL/mg with sensitivity of

85% and specificity of 96%. PCC seems to be a marker of SIRS positivity in horses.

Key words: SIRS, biomarker, protein carbonyl.

Quantification of Right Ventricular Volumes in Healthy Horses using Real-time 3-D Echocardiography

J.C.Reed[1], R.C.Jago[1], K.Blissitt[1], L.E.Young[2], R.Shave[3+4], J.Keen[1]

[1]Royal (Dick) School of Veterinary Studies & The Roslin Institute, University of Edinburgh, [2] Specialist Equine Cardiology Services, Moulton, Suffolk, [3]Cardiff Metropolitan University, Cardiff, [4]University of British Columbia, Kelowna, Canada

A reliable method of right ventricular (RV) volume calculation in the horse does not exist. This study evaluated the feasibility and reliability of three-dimensional echocardiography (3DE) for measuring right-ventricular volumes in twelve healthy Thoroughbreds in training (ages 3-10). Left parasternal long axis (L-RV) and right parasternal right-ventricular outflow tract views (R-RV) were acquired by two observers in unsedated horses using a GE Vivid E9 ultrasound machine with a 3V-D transducer. Single-beat and multi-beat (2-beats) images were taken at frame rates between 12.2-15.2 FPS. Analysis was blinded, randomized and performed with the 4D Auto RVQ package, GE EchoPAC Software (v.202), with both automatic and manual border tracking. Measurements were calculated as an average of 3 consecutive cycles. Reliability of 3D methods was assessed by calculating the inter-observer and intra-observer within-day and between-day acquisition variability and measurement variability, reported as the coefficient of variation (CV). Additionally, 3DE stroke volumes were compared to pulsed-wave Doppler derived values. Volumetric analysis was possible from all recordings. The L-RV single-beat automatic method was the most reliable with low-moderate variability for all measures (CV 6.8-17.56%). Reliability of other methods ranged from low to high. Generally, endocardial border tracking was inaccurate based on visual assessment, and 3DE methods underestimated stroke volumes compared to Doppler, with differences of 293 ± 225 ml to 612 ± 315 ml (mean±SD). These results suggest 3DE is a feasible and repeatable method, but poor endocardial tracking of the ventricular free-wall may limit accurate identification of changes in ventricular volumes longitudinally and should be further investigated.

Keywords: 3-dimensional echocardiography; right-ventricle; volume

Is MMP-9 a valuable diagnostic marker of sepsis and endotoxemia in equine colic?

Ann Kristin Barton[1], Ina-Gabriele Richter[2], Tanja Ahrens[1], Abdollah Alalwani[1], Dirk Barnewitz[2] and Heidrun Gehlen[1]

[1]Equine Clinic, Freie Universitaet Berlin, Berlin, Germany and [2]Research Centre of Medical Technology and Biotechnology, Bad Langensalza, Germany

In this study, we evaluated matrix-metalloproteinase-9 (MMP-9) in plasma and peritoneal fluid as a sepsis marker in equine colic patients. Results of sepsis scoring were compared to the concentrations of MMP-9. A modified sepsis scoring including general condition, heart and respiratory rate, inner body temperature, mucous membranes, white blood count (WBC) and ionized calcium was performed in 47 horses presented with colic. Using this scoring system, horses were classified as negative (n = 32, ≤ 6/15 points), questionable (n = 8, 7-9/15 points) or positive (n = 6, ≥ 10/15 points) for sepsis. MMP-9 concentrations were evaluated in plasma and peritoneal fluid using species-specific sandwich ELISA kits. In a linear discriminant analysis, all parameters of sepsis scoring apart from calcium separated well between sepsis severity groups ($P<0.05$). A significant influence of overall sepsis scoring on MMP-9 was found for peritoneal fluid ($P = 0.007$) with a regression coefficient of 0.131, while no association was found for plasma ($P = 0.078$). A MMP-9 concentration of >110 ng/ml in peritoneal fluid was found to be the ideal cut-off to identify positive sepsis scoring (≥ 10/15 points; sensitivity of 85.7 % and specificity of 87.5 %). MMP-9 was found to be a biomarker of high diagnostic value for sepsis and endotoxemia in equine colic. Peritoneal fluid seems preferable in comparison to plasma.

As abdominocentesis is commonly performed in the diagnostic work-up of equine colic, a pen-side assay would be useful and easy-to perform diagnostic support in the decision for surgery and prognostic estimation.

Key words: MMP-9, sepsis, colic, endotoxemia, horse

Corresponding author: PD Dr. Ann Kristin Barton, Equine Clinic, Department of Veterinary Medicine, FU Berlin, Oertzenweg 19b, 14163 Berlin

Photodermatitis and Ocular Changes in Nine Horses after Ingestion of Parsnip (*Pastinaca Sativa*)

Judith C. Winter[1], J. Corinna Eule[2], Katharina Thieme[2], Eva-Maria Saliu[3] and Heidrun Gehlen[1]

[1]Equine Clinic: Surgery and Radiology, Freie Universität Berlin, Germany. [2]Small Animal Clinic, Freie Universität Berlin, Germany. [3]Institute of Animal Nutrition, Freie Universität Berlin, Germany

Photodermatitis rarely occurs in horses and was reported after ingestion of different plants or chemicals and in patients with hepatic insufficiency. Nine horses from three different stables presented with variable degrees of erythema, crusting and necrosis of unpigmented skin at the head and prepuce. Extremities were unaffected. Horses were of different breeds with a median age of 15 ± 5.9 years. 1/9 horses showed a mild leukocytosis at admission. Liver enzymes were within the reference ranges in all horses. Ocular changes were seen as follows: blepharitis 3/9, conjunctivitis 7/9, corneal edema without additional signs of keratitis and/or uveitis 2/9, corneal edema with signs of uveitis 1/9 and photophobia 4/9. Only one horse developed a fluoreszein positive corneal erosion within 4 days. Skin biopsy (1/9) revealed a moderate to severe acute, eosinophilic and lymphocytic dermatitis with severe dermal edema and vasculitis. All stables fed hay from the same hay distributer with a high content of parsnip (plants, seeds, roots). Parsnip is widespread in Europe and contains furocoumarins, a family of photodynamic pigments, which may cause primary photosensitization, corneal edema and keratoconjunctivitis.

Horses were treated according to severity of clinical symptoms systemically with flunixine meglumine (1.1 mg/kg BW 1-2x/day) or prednisolone (1 mg/kg BW 1x/day). Topically, either gentamicin (3x/day), dexamethasone (2-3x/day) and/or atropine (1x/day) were used. Skin care was provided with almond oil or dexpanthenol (2x/day). All horses were kept in a dark environment or treated with sunscreen and face-masks. Duration of treatment varied from 6 to 30 days (median 11.3 days).

Keywords: Photodermatitis; Parsnip; Furocoumarins; Intoxication; ocular changes, cornea

Comparison of Airway Cytology in Healthy Adult Horses Housed Either on Peat Bedding or Wood Shavings

Jenni Mönki[1], Minna Rajamäki[1], Marja Raekallio[1], Ninja Karikoski[1], Markku Saastamoinen[2], Anna Mykkänen[1]

[1] Department of Equine and Small Animal Medicine, University of Helsinki, Helsinki, Finland. [2] Natural Resources Institute Finland, Jokioinen, Finland

Asthma is common in many equine populations and airborne particles are recognised as potential predisposing factors in disease pathogenesis. The aim of our study is to investigate effects of two bedding materials, peat and wood shavings on equine airway health. 32 clinically healthy adult riding school horses were stalled on different bedding materials for 35 consecutive days (peat – wood shavings – peat) during September – December 2018. The horses remained in the same stalls and the feeding, exercise or management did not change during the study period. Clinical examination was performed and tracheal wash (TW) and bronchoalveolar lavage fluid (BALF) samples were obtained for cytological analyses at the end of each period. TW and BALF neutrophil percentages were compared with repeated samples T-Test using horses as their own controls. Significance was set at $P < 0.05$. The horses remained healthy during the study period. TW neutrophil percentage was higher after the shavings period (mean ± SD; 32.8 ± 25.0) compared to first (17.2 ± 15.9; $P = 0.009$) or second peat period (13.1 ± 15.9; $P < 0.001$). BALF neutrophil percentage was lower after the second peat period (1.6 ± 1.1) compared to the shavings period (3.4 ± 3.1; $P = 0.002$) or first peat period (2.7 ± 2.2; $P = 0.008$).These preliminary results suggest that wood shavings increase airway neutrophilia detected in tracheal secretions compared to peat bedding. The result might be helpful in choosing bedding material for horses with equine asthma.

Key words: Equine asthma; BALF; Cytology; Neutrophils; Bedding material

Retrospective study of 25 clinical cases of acorn intoxication presented at CISCO-ONIRIS in France between 2011 and 2018

Tanguy Hermange[1,2], Basile Ruault[2], Paul Flambard[2], Anne Courouce[1,2]

[1]Unité de nutrition, PhysioPathologie et Pharmacologie (NP3), Ecole nationale vétérinaire, agro-alimentaire et de l'alimentation Nantes-Atlantique (Oniris), Université Bretagne Loire (UBL), Nantes F-44307, France ; [2]CISCO (Centre International du Cheval d'Oniris), Ecole nationale vétérinaire, agro-alimentaire et de l'alimentation Nantes-Atlantique (Oniris), Nantes F-44307, France

We aim to describe clinical data associated with acorn intoxication and to find factors associated with survival. Data from horses presented at CISCO-ONIRIS from 2011 to 2018 with a diagnosis of acorn intoxication were included. Diagnosis was based on: season, presence of acorns in the environment, clinical and hemato-biochemical parameters suggestive of a digestive/renal disease, co-morbidity of companion animals, and post-mortem findings. Statistical analysis was done using a student test for mean comparisons and Chi-square test for group comparisons ($p<0.05$). A total of 25 horses were included: 2 cases in 2011, 0 between 2012 and 2014, 8 in 2015, 0 in 2016, 15 in 2017, and 0 in 2018 suggesting that the intoxication depends on the year and that the number of cases seems to increase. Clinical signs associated with acorn intoxication were signs of circulating shock (depression, tachycardia, abnormal mucous membrane, tachypnée), digestive signs (diarrhea, ileus, colic), and abnormal temperature. Clinical pathological findings included increased PCV, WBC, creatinine, BUN, GGT, AST, CK and decreased albumin. Overall 44% horses survived; 13/14 of non-surviving horses died during the first 48 hours. Findings significantly associated with non-survival were: older age, hemorrhagic diarrhea, heart rate, PCV, creatinine, blood lactate, and thickness of the colon wall at ultrasonography. Using threshold of PCV>60%, Lactate>4.5mmol/L, Creatinine>26mg/L, colon wall thickness>22mm, positive predictive value for non-survival was above 90% for each parameter. Acorn intoxication seems to increase in the West of France. Age, hemorrhagic diarrhea, heart rate, PCV, creatinine, lactates, and colon wall thickness help in assessing prognosis.

Key words: acorn, intoxication, clinical data, prognosis, survival

Hepatic Insulin Signaling in Insulin-Dysregulated Horses after Oral Glucose Administration

Florian Frers[1], Julien Delarocque[1], Karsten Feige[1], Korinna Huber[2], Tobias Warnken[1]

Clinic for Horses, University of Veterinary Medicine Hannover, Buentweg 9, 30559 Hannover, Germany. Institute of Animal Science, Faculty of Agricultural Sciences, University of Hohenheim, Fruwirthstr. 35, 70599 Stuttgart, Germany

Insulin Dysregulation (ID) encompasses different disorders like hyperinsulinemia and insulin resistance. The aim of this study was to determine if ID is associated with altered expression of key proteins of the insulin signaling cascade (ISC) in liver tissue under basal and/or stimulated conditions. Twelve Icelandic horses were subjected to an Oral Glucose Test (OGT) with 1 g/kg bwt glucose administered via nasogastric tube. Liver biopsy samples were taken at basal conditions and at 120 minutes of the OGT. Expression levels of AMPK α, InsR, mTOR and PKB as well as their extent of phosphorylation were determined by Western Blot. Insulin levels at 120 minutes measured by

ELISA, revealed that 6 horses were insulin-dysregulated while 6 were not. No significant differences in basal protein expression could be identified by two-way repeated measures ANOVA with Holm adjustment for multiple testing between groups. Phosphorylated insulin receptor (pInsR) was expressed at significantly higher levels upon glucose stimulation (p=0.011), whereas phosphorylated AMPK α was downregulated (p=0.036). Linear regression of pInsR against insulin under stimulated conditions revealed that in healthy horses there was a significant positive linear relationship between both variables (p=0.021) while it was negative in dysregulated horses (p=0.015). These results indicate that while the expression levels of these key proteins of the ISC do not seem significantly different in insulin-dysregulated horses, the phosphorylation of InsR appears impaired, possibly indicating an insulin resistance. As insulin-dysregulated horses are not necessarily insulin-resistant, it remains to be investigated if this is a tissue specific response.